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Mineralogical and chemical variability of soils across a tropical ocean island climate gradient, San Cristóbal, Galápagos

Madelyn Percy and Larry Benninger

University of North Carolina at Chapel Hill, Geological Sciences, United States of America (madelynp@live.unc.edu)

Little data currently exist on the chemistry of soils on the island of San Cristóbal, Galápagos, despite the importance of this data in understanding how the island has weathered through time. We sought to resolve this lack of data by surveying soils from different elevations and in different climate zones across the island. We collected soil samples from transects and sites across a precipitation-gradient in order to describe the mineralogy and chemistry of the soils, and to understand how soils have weathered in different precipitation regimes across the island. We used a mass balance approach, coupled with chemical weathering indices, to understand profile-scale to site-scale differences in weathering.

Climate-dependent shifts in soil characteristics are apparent: at the wettest sites, the soils have the lowest pH, the highest percentage of amorphous material, and the highest loss on ignition values. We compared the saprolite, the basal material from the soil pits in which the basalt bedrock's texture was still apparent but the material was extremely friable, and previously reported unweathered bedrock data, showing that the saprolite was highly weathered relative to the unweathered bedrock. Using the mass balance approach, we show that while base cations have been lost from soils relative to the parent material underlying the profiles, aluminum and iron concentrations have remained the same or have increased.

We used chemical indices of weathering as evidence for the relationship between weathering intensity and precipitation, with greater weathering intensity observed in the very humid highlands compared to the less intense weathering that has occurred in the arid lowlands. The windward side of the island shows higher intensities of weathering than the leeward side. Our findings conform with other soil chemistry studies on the islands of Santa Cruz and Isabela, also in the Galápagos archipelago, showing that more intense weathering, accompanied by a greater loss of mobile elements, is observed at wetter sites.